The Army's Science an

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With our Army at war, the Army's science and technology (S&T) strategy is to mature technology to ensure our Soldier's dominance on the battlefield today and in the future. As the S&T community simultaneously invests in research and development (R&D) to create new understanding, it is translating that research into militarily useful mature technology that is relevant to today's operational environments. Today's S&T investments are essential for exploiting technology opportunities that will speed solutions for enhancements to Current Force systems and better enable a technologically advanced Future Force. The S&T strategy is implemented through a diverse and dynamic investment portfolio that is synchronized with warfighter needs to ensure responsiveness.

DARPA's S&T investments in spiraled, mature technology have led to networked battle command systems that enable shared SA and improved battlefield decision making. Here, Soldiers from B Co., 1st Battalion, 5th Infantry Brigade, 25th Infantry Division (Light) Stryker Brigade Combat Team use networked SA to relay information to the command group while on patrol near Mosul, Iraq, March 31, 2005. (U.S. Air Force photo by TSGT Mike Buytas, 1st Combat Camera Squadron.)

d Technology Strategy

The Army is maintaining its commitment to transform into a lighter, more lethal and strategically responsive force. The Army's transformation is framed to support the overall DOD transformation and is focused on building a campaign-quality force with Joint and expeditionary capabilities. Similarly, the S&T program is synchronized with developments across DOD, other federal agencies, academia and industry partners in the United States and abroad. The Army S&T program is contributing to the global war on terrorism (GWOT) today by enabling limited fielding of advanced technologies and providing in-theater technical expertise.

S&T Contributions to GWOT

Army S&T supports our Soldiers fighting the GWOT in three ways:

- We are benefiting today from technologies that emerged from past R&D investments.
- We are exploiting transition opportunities from ongoing S&T efforts.
- We are leveraging the expertise of Army scientists and engineers to develop solutions for potential challenges.

To better illustrate how returns on past investments are benefiting Soldiers on the battlefield today, let's examine the groundbreaking R&D done at the Natick Soldier Center (NSC) in advanced fiber technologies. Since the mid-1980s, in partnership with industry, NSC has labored to create lighter weight ballistic protection for Soldiers. This research produced the technologies to develop the outer tactical vest and components for the Small Arms Protective Insert plates (SAPI plates) that are used by Soldiers deployed worldwide today. In fact, we've increased our industrial base capacity from making 1,200 sets of SAPI plates a month to 25,000 sets per month.

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Another example of how the S&T community is helping wage the GWOT is by exploiting technologies from current investments. Radio frequency jamming technology solutions from investments in our electronic warfare technology program have been incorporated into the family of Warlock systems that are being used to defeat radio-controlled improvised explosive devices (IEDs) in Afghanistan and Iraq. This new technology has saved countless Soldier and civilian lives from insurgent-placed IEDs.

Likewise, by leveraging S&T expertise to solve unforeseen or potential problems, engineers at the Army Research Laboratory (ARL) and Tank Automotive Research, Development and Engineering Center (TARDEC) have gained extensive experience in designing armor and appliqués for Army combat vehicles. This team rapidly responded to a critical battlefield need by designing and demonstrating armor survivability kits (ASKs) for Humvees as well as M939 and M35 series vehicles to provide protection against small-arms fire and IED fragments. (Editor's Note: See the Nov-Dec 2004 issue of *Army AL&T* Magazine, Pages 68-70.) These ASKs have now been installed on more than 12,000 Humvees and nearly 1,500 medium and heavy trucks deployed to support the GWOT.

Collectively, these efforts are enhancing Current Force capabilities for fighting the GWOT by applying

relevant technologies to satisfy existing and emerging operational requirements.

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S&T Contributions for the Future Force

Soldiers are the center of the Army's transformation focus. Army S&T supports the Soldier-as-a-System (SaaS) concept to equip Soldiers with integrated modular ensembles that can be tailored to specific missions. These ongoing efforts are described in the NSC article on Page 26 of this issue of *Army AL&T* Magazine. More specifically, S&T efforts in training and leader development have led to breakthrough training management tools to improve the effectiveness of interactive distributed training systems and methodologies that use realistic synthetic experience to accelerate the development of critical thinking and interpersonal communication skills. The Army Research Institute and the Simulation and Training Technology Center describe several of these efforts in the article on Page 31.

Future Combat Systems (FCS)

We have a significant S&T investment in FCS technology. The FCS system development and demonstration program is taking advantage of past Army S&T investments as well as those jointly developed with the Defense Advanced Research Projects Agency (DARPA) to achieve initial fielding in 2014. Today's S&T program continues to pursue FCS technologies for spiral insertions. Key FCS S&T investments include:

- Networked battle command systems that enable shared situational awareness (SA) and improved decision making.
- Networked lethality through standoff precision missiles and gun-launched munitions.
- Enhanced survivability through networked lethality, improved sensors to locate and identify threats, signature management and active and passive protection systems.
- Semiautonomous and autonomous unmanned air and ground systems.
- Low-cost, multispectral sensors to find and identify the enemy.

Unmanned Aerial and Ground Systems

The FCS-equipped Unit of Action (UA) will be the first Army organization designed to integrate unmanned systems and manned platforms into ground maneuver combat operations. Army S&T is developing unmanned and robotic capabilities that include: unmanned aerial vehicles (UAVs), unmanned ground vehicles, unattended sensors and unattended munitions. These systems' capabilities will be modular in design for rapid adaptation to changes in mission needs.

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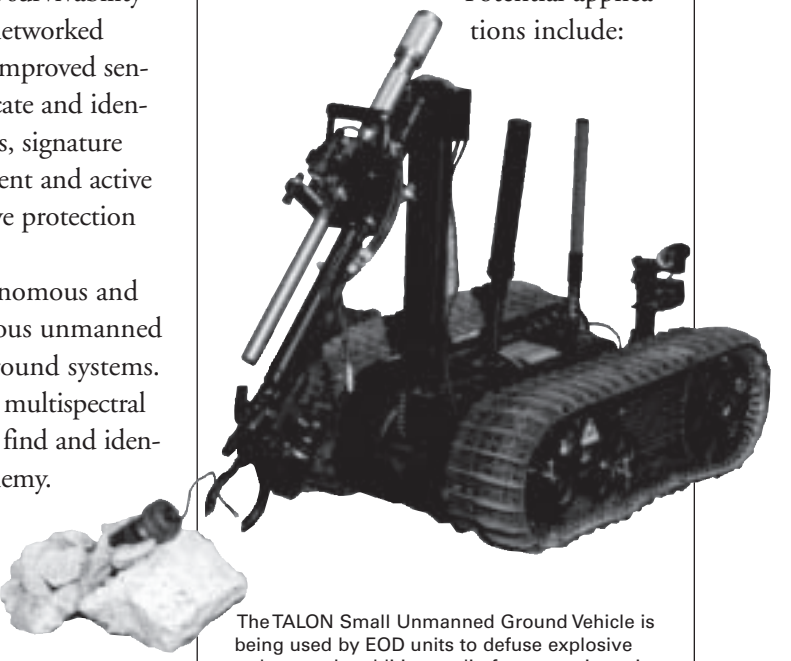
The unmanned and unattended systems can be used in maneuver, maneuver support and maneuver sustainment roles to augment Soldier capabilities. The unmanned systems and technology applications provide for capabilities that are not available today and reduce risks to Soldiers while simultaneously reducing logistics demand generated by operational requirements. Potential applications include:



The TALON Small Unmanned Ground Vehicle is being used by EOD units to defuse explosive ordnance. In addition, radio frequency jamming technologies have been incorporated into the family of Warlock systems that are being used to defeat radio-controlled IEDs. (U.S. Army photo by Mike Roddin.)

- Increased standoff detection capabilities of FCS-equipped UAs to improve commanders' ability to shape the battlespace and set conditions for decisive operations in less time.
- Increased UA capabilities for extended periods during economy of force and distributed operations.
- Ability to allocate solely unmanned systems with lethal capabilities in selected battlespace areas through networked battle command.
- Sustained UA maneuver operations through standoff mine detection and neutralization.

Force Protection

Our first priority is to provide the best available technology to

protect our Soldiers. Our system-of-systems approach includes: Interceptor Body Armor, electronic countermeasures (Warlock) and lightweight armor kits for tactical vehicles. Other examples include:

- Acoustic and radar sensors for detecting and locating the source of rocket, artillery and mortar fire.
- Infrared technology for countersniper operations, providing warning and locations for counter fire.
- Medical technology to protect Soldiers from endemic diseases and provide rapid treatment to save lives, such as the Chitosan Bandage and one-handed tourniquet.

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The S&T community continues to make significant progress in maturing the sensor and kill mechanism technologies to enable full-spectrum active protection systems (APS). APS will significantly increase the survivability of lightweight platforms. We are funding both close-in and standoff protection systems to defeat chemical energy and kinetic energy munitions. We are sustaining investments in APS technologies and advanced lightweight armors to enable an integrated survivability suite for FCS and other lighter weight combat systems.

In the past year, we demonstrated the ability to defeat rocket-propelled grenades (RPGs) fired from very close ranges. Our APS technology defeated the following RPG threats in two different scenarios:

- A single RPG fired against a moving vehicle.
- Two RPGs fired nearly simultaneously at a stationary vehicle.

Other S&T Initiatives

The Army's diverse S&T portfolio invests in a range of technologies to provide solutions across a spectrum of desired capabilities beyond those already discussed for FCS and SaaS. These

ARL and TARDEC engineers and scientists have gained extensive experience in designing armor appliqués for Army tactical vehicles. ARL/TARDEC-designed ASKs for Humvees and other medium and heavy trucks help provide protection against small-arms fire and IEDs. (U.S. Army photo.)

other initiatives pursue technology solutions to satisfy capability gaps across the entire force. Examples of these investments include:

- Mobile, secure and self-organizing networks for seamless Joint operations.
- Countermine and counter-IED technology for combat and stability operations.
- Lightweight, multimission equipment packages for unmanned systems.
- Immersive simulations and virtual environment technologies for Soldier, leader and unit mission rehearsal and training.
- Embedded prognostics and diagnostics to reduce logistical demands for materiel systems.
- Expedient protective designs, lightweight/blast-resistant materials, pre-detonation screens and other protective barriers for base protection from rocket, artillery and mortar attacks.
- Alternative and variable lethality mechanisms including high-power microwave, high-power lasers and electromagnetic guns.
- Medical technology for self-diagnosing and treating "uniform" ensembles.
- Genomic, DNA-based vaccines to sustain Soldier and unit combat effectiveness.

Technology Partnering

The Army uses partnerships to promote a "competition of ideas" to identify and leverage the best and most cost-effective state-of-the-art technology for Army applications. The Army's collaboration with DARPA on FCS is an outstanding example of technology partnering. In addition, the Army has established University Affiliated Research Centers (UARCs) to address paradigm-shifting technologies in cooperation with academia and industry. The Institute for Creative Technologies (ICT) at the University of Southern California leverages the resources of the entertainment and game industry to foster advances in simulation and virtual environment technologies for training. The Institute for Soldier Nanotechnologies at the Massachusetts Institute of Technology is researching protective materials capable of shielding Soldiers from attack and harsh environments. The Institute for Advanced Technology at the University of Texas was established to harness the knowledge necessary to create a new class of electric weapon systems. The Institute for Collaborative Biotechnologies at the University of California-Santa Barbara will perform cutting-edge research in biologically inspired materials and sensors.

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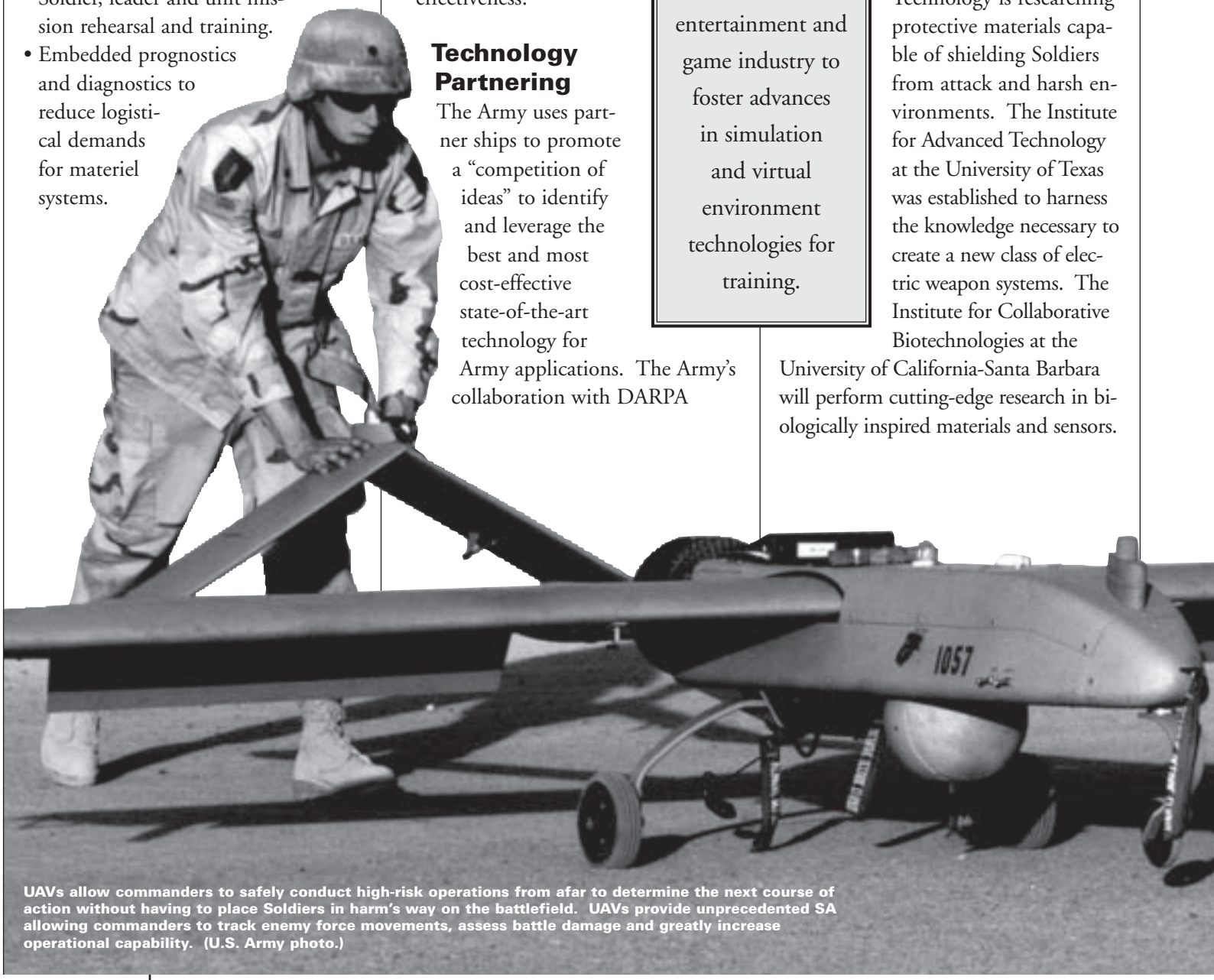

UAVs allow commanders to safely conduct high-risk operations from afar to determine the next course of action without having to place Soldiers in harm's way on the battlefield. UAVs provide unprecedented SA allowing commanders to track enemy force movements, assess battle damage and greatly increase operational capability. (U.S. Army photo.)

The work being orchestrated by the UARCs and other major R&D efforts in the Army's research program are described more fully in articles on Army basic research programs in this issue of *Army AL&T* Magazine.

The Army's new Flexible Display Center at Arizona State University-Tempe (see Page 72) will partner with industry, other universities and the government to advance flexible display technology and manufacturing for unique Soldier applications. The Army's goal is to demonstrate the technology for rugged, low-power flexible displays that will provide enhanced information and SA for Soldier and vehicle platforms.

The Army has also aggressively pursued a business innovation to exploit technology opportunities through a venture capital corporation (VCC). The VCC's goal is to develop "better collaborative ties with the young, small, growth-oriented companies that take risks and push innovation." The Army VCC focuses on its investment activities with companies and programs developing power and energy technology applicable for individual Soldier requirements. This effort's first success is the development and fielding of a battery state-of-charge indicator, enabling Soldiers to start a mission with confidence that the batteries they carry are charged and mission capable.

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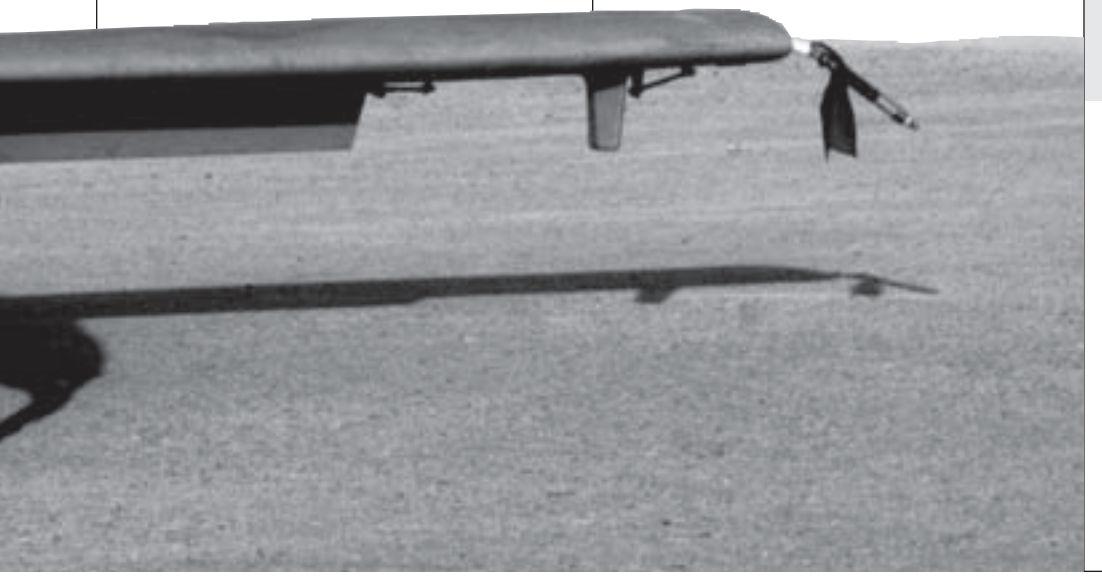
Manufacturing Technology (MANTECH)

The Army MANTECH program's goal is to make advanced technology affordable and producible. Ultimately, the Army benefits from enhanced capabilities and reduced total ownership costs. The Army focuses its MANTECH program on manufacturing challenges in armor, electronics/power systems, munitions and sensors to overcome barriers to affordable production and to increase the production yield of advanced technologies for Current and Future Force systems. MANTECH investment strategy advocates transitioning technology directly to acquisition program managers and industry.



The Army's scientists and engineers are focused on achieving results. Our results-oriented approach relies on a close partnership with our warfighting customers and the wider S&T community. Our pursuit of innovation exploits technical capabilities in the other services, agencies, international resources, industry and academia. The Army's focused and balanced S&T portfolio is providing solutions for the Current Force today while investing in and demonstrating technologies for the Future Force.

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